



SPECIFICATION  
FOR  
SHORT NEUTRAL SECTION ASSEMBLY  
(PHASEBREAK)

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ISSUEDBY

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Amendment	Date of Amendment	Total pages including drawings	Amendment/Revisions
1	May, 2017	7	Revision-1
2	.....2020	7	Revision-2

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(i) **SCOPE:** This specification covers the requirement of Short Neutral Section Assembly also called as Phase Break (**herein after referred as SNS**) for use in 25kV A.C. Single Phase 50 Hz, Traction Overhead Equipment (OHE) and supersedes Specification No. ETI/OHE/63(5/91). SNS provides electrical isolation between the two phases (Phase break value of 120° ) of 25 kV AC OHE. Specification is revised to incorporate field operating conditions, make it more general & to update latest standards.

1. **DEVIATIONS FROM SPECIFICATION:** Any deviations from this Specification to improve the performance, efficiency and utility of the equipment, proposed by the manufacturer will be given due consideration on merits provided full technical particulars with justification therefore are furnished. In such a case, the manufacturer shall quote according to this Specification and indicate the deviation(s) separately in a "Statement of Deviations".

2. **SERVICE CONDITIONS:**

3.1 SNS has to withstand in service following Limiting weather conditions:

S.N.	Conditions	Value	Note
1.	Max. Temperature of air in shade	45°C	The SNS assembly shall be suitable for outdoor use in moist tropical climate and areas subjected to heavy wind, rainfall and severe lightning in India.
2.	Min. Temperature of air in Shade	0°C	
3.	Max. Temperature attainable by an object exposed to sun	65°C	
4.	Max. Relative humidity	100%	
5.	Average annual rainfall	1750 to 6250 mm	
6.	No. of thunder storm days/annum	35 Max.	
7.	No. of dust storm days/annum	35 Max.	
8.	No. of rainy days per annum	120	
9.	Max. Wind pressure	216 kgf/sq m	
10.	Altitude	Up to 2500 m from sea level.	

3.2 The OHE in which the SNS is to be installed is subject to vibrations caused by wind and passage of trains/Pantographs. The SNS is required to provide smooth passage to the pantograph(s) of electric locomotives, electric multiple units (EMU) in either direction up to a maximum operating speed of 200 km/h. The pantograph used on the locomotive/EMU is AM-12 and AM-92 type fitted with metalized carbon strip. In future, use of pure carbon strips can be made. The static thrust of pantograph varies from 6 to 9 kgf.

3.3 The SNS shall be suitable for installation at the Cantilever Assembly (~~refer clause 4.7~~) with simple regulated OHE consists of following combination catenary conductor and contact wire. The details of which shall be obtained by the supplier from the purchaser.

Combin-ation	Catenary wire		Grooved Copper Contact Wire	
	Size	Breaking Load Kgf (Min)	Size	Breaking Load kgf(Min)
i	19/2.10mm, 65mm <sup>2</sup> cadmium copper	3920	107 mm <sup>2</sup>	3905
ii	19/2.10mm, 65 mm <sup>2</sup> cadmium copper	3920	150 mm <sup>2</sup>	5475
iii	<del>19/2.79mm, 65 mm<sup>2</sup> aluminum alloy</del>	<del>3311</del>	<del>107 mm<sup>2</sup></del>	<del>3905</del>

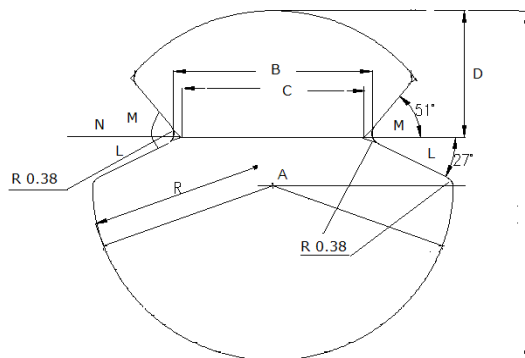
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iv	37/2.10mm, 125 mm <sup>2</sup> cadmium copper	7650	150 mm <sup>2</sup>	5475
v	37/2.10mm, 125 mm <sup>2</sup> cadmium copper	7650	193 mm <sup>2</sup>	7045
vi	37/2.92mm, 242mm <sup>2</sup> cadmium copper	9140	193 mm <sup>2</sup>	7045
vii	37/3.35 mm 323 mm <sup>2</sup> Hard drawn Standard copper Catenary Wire.	12202	193 mm <sup>2</sup>	7045

3.4 The working tension in each of catenary and contact wire may vary from 1000 to 2000 kgf. The SNS shall be suitable for installation at steep gradient and sharp curvatures.

2.5 Contact wire configuration is shown below-

Cross section of Contact wire mm <sup>2</sup>	Dimensions				Angle(Degree)		
	A	B	C	D	L	M	N
107	12.24±0.16	6.92±0.15	6.5	4.43	27+1-0	51+1-0	78+2-0
150	14.5±0.20	6.92±0.15	6.5	4.00	27+1-0	51+1-0	78+2-0
193	16.4±0.15	8.50±0.18	8.1	5.3	27+2-0	51+1-0	78+3-0



3.6 Occasionally Locomotive or EMUs may move under the SNS without opening of the circuit breaker and SNS should be designed so that SNS does not fail or damage or affect the operation of the train or need not require any immediate maintenance or any major repair during such occasions. For this, manufacturer shall submit the design details.

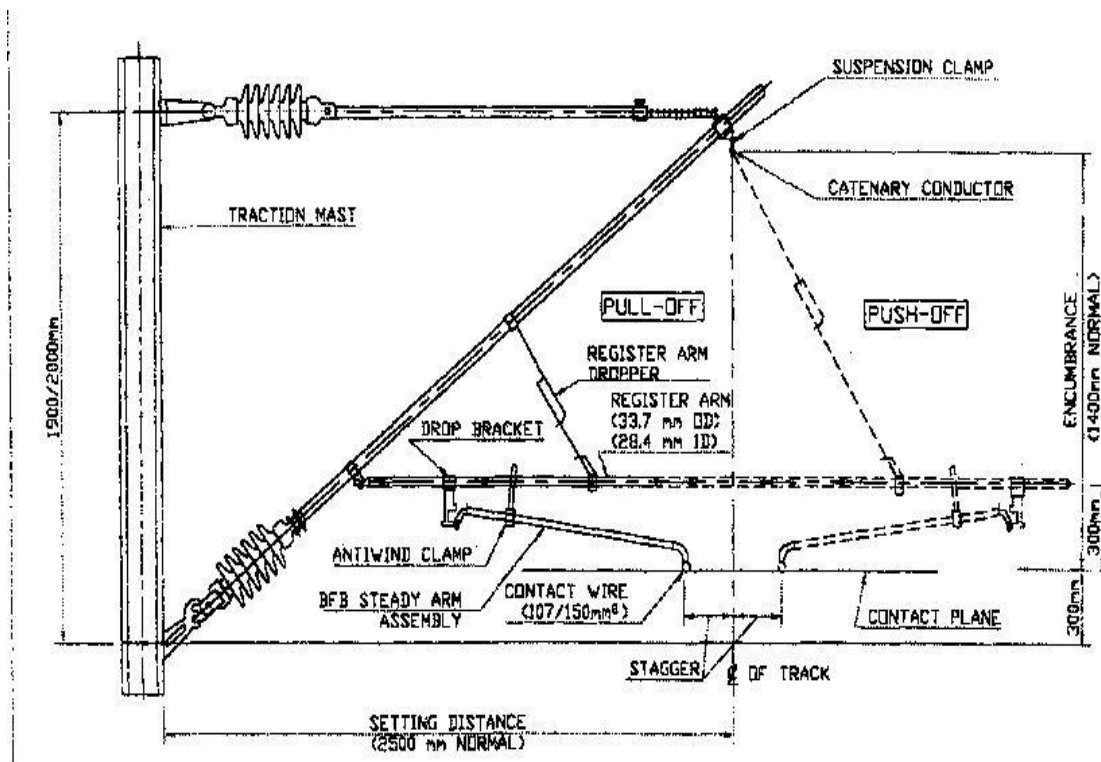
4. **GENERAL CONSTRUCTION:** The SNS shall consist of the following:

- 4.1 Resin bonded fibre glass (or equivalent) insulators covered with PTFE (or equivalent) Circular in cross section, adequately dimensioned and rated for application shall be provided in the contact and catenary wire.
- 4.2 The insulators referred at 4.1 shall have suitable end fitting for connections to the middle contact wire & running contact wire and catenary wire through end fitting respectively. The end fittings for the contact and catenary conductor shall be provided by the manufacturer.
- 4.3 The SNS shall be such that the pantograph passes from contact wire to insulator and vice-versa smoothly without any shock. For this purpose ~~stainless~~ runners/glidors preferably of stainless steel/**copper** shall be provided or alternatively any other means if found suitable may be adopted. If material of runners/ glidors other than stainless steel/**copper** is proposed by the manufacturer then clause 2 shall be referred.
- 4.4 Manufacturer shall specify, if 'the earthing' of the central portion of the SNS is required or not. And also submit the technical details for suitability of the design. If earthing is required as per the design then the Earth Wire assembly [copper Earth wire with diameter 12.0 to 13.0 mm of sufficient length suitable for push off and pull off locations (as shown below), Earth wire clamps for contact and catenary wire, lug suitable for M16 bolt for other end] shall be provided by the manufacturer.

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4.5

**Cantilever Assembly**



4.6 Manufacturer shall provide arc extinguishing assembly to extinguish any arc current caused by break of contact between pantograph and live contact wire when pantograph passes from contact wire to insulator and also to comply clause 3.6.

4.7 The clearance between ~~arc trap~~ **arcing horn** and nearest live portion will be specified by the manufacturer. ~~Manufacturer will submit design calculation for the same. This clearance shall be available at the arc trap~~ **arcing horn** itself. ~~Raising or lowering of arc trap~~ **arcing horn** for adjustment of clearance leading to adjustment of register arm tube shall not be permitted.

4.8 The distance between contact plane and the Centre of register arm tube is 300 mm fixed. Therefore, the ~~arc trap~~ **arcing horn** shall be positioned in such a manner that this distance of 300 mm is not at all disturbed. If the ~~arc trap~~ **arcing horn** is proposed to be suspended from register arm tube through suitable rigid attachments, the dimension of register arm tube 33.7 mm OD/28.4 mm ID standard should be kept in view. During the passage of pantograph there shall be no disturbance in the electrical clearance once it is fixed. Suitable means of suspension of the components of the assembly from the catenary conductor shall be provided.

4.9 The SNS shall be as light as possible and so constructed that adjustment of components can easily be made during erection and maintenance and also for ensuring smooth passage of pantograph.

4.10 The SNS shall be suitable for erection symmetrically on the cantilever assembly which is having one point each for suspension of catenary conductor and contact wire.

4.11 All the fasteners and ferrous parts shall be of stainless steel and shall comply with clause 9.13.

4.12 Manufacturer's initials month and year of manufacture and Part No. shall be clearly etched/embossed on each of the components for easy identification. The Letters/figures shall normally be 5 mm in height. In addition each insulator shall be marked with Specified Mechanical load (SML). The markings on the insulators shall be legible and indelible. Etching/embossing on the components which are otherwise very small is not necessary

5. All components of the SNS shall be freely interchangeable between one assembly and the other.

6. **PACKING AND MARKING:**

6.1 The fittings and components excluding insulators of the SNS shall be suitably packed to prevent damage during transit/handling. Every box shall contain following:

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I	List of fittings/components giving quantity of each item packed in the box
II	Erection and maintenance instructions/drawings for assembling fitting/components to form the complete short neutral section assembly

6.2 The insulators properly wrapped and protected from damage during transit storage/handling shall be packed separately in strong boxes. Every box shall carry in legible and indelible lettering the following information:

i	Manufacturer's name	ii	Number of insulators/components of assemblies packed
iii	Consignee's address	iv	Contract/purchase order number with date
v	Date of inspection and inspecting authority	vi	Any other particulars specified by the purchaser

7. **DOCUMENTS:** Manufactures shall submit the following for scrutiny:

7.1 Schedule of guaranteed technical particulars as per Annexure-I along with registration application.

7.2 Detailed literature on erection, maintenance etc. of the SNS.

7.3 Detailed list of spare parts which are required for replacement during the service.

7.4 The following drawings for each component and the assembly in one sets in standard size of 210 mm x 297 mm or multiples thereof.

- i) Drawing showing the SNS Assembly (Plan, Elevation and End view) indicating major dimensions and clearly specify the effective Neutral length without pantograph and with pantograph of 450mm width, total length, Total weight of the Assembly along with Speed Potential.
- ii) Assembly drawing of parts/components showing major dimension including tightening torque off fasteners.
- iii) Detailed dimensional drawings of each part/component indicating tolerances along with material specification and grade necessarily.
- iv) Drawings deemed necessary by the Manufacturer or as required by the Purchaser.

**Note: 1. Each drawing shall carry the following:**

1. Tabulation:

Item Reference	Item's Name	Drawing Number	material	Material specification, grade	Quantity	Weight
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2. Salient technical particulars and features of the assembly/components.

3. A block for approval by RDSO :

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7.5 After all the drawings are approved, the manufacturer shall submit three Reproducible Tracing Films set of each drawing for signature of approving authority.

7.6 Only after all the design and drawings have been approved and clearance given by purchaser/RDSO to this effect, the manufacturer shall take up manufacture of the prototype for RDSO's inspection.

7.7 Any changes advised by RDSO required to be done in the prototype shall be done expeditiously.

8. **TESTS:**

8.1 The manufacturer shall arrange for tests at the premise as indicated in the STR (Schedule of Technical Requirement).

8.2 Before giving call to RDSO for inspection/testing of the prototype of the SNS, the manufacturer shall submit detailed test schedule consisting of details of each of the tests, venue of the test, duration of each test and the total number of days required to complete the tests at one stretch. **If the test can not be completed, then in second visit it shall be completed.** Once the schedule is approved, the tests shall invariably be done accordingly. However, during the process of type testing or even later, RDSO reserves the right to conduct any additional test(s) besides those specified herein, on the assembly/component/system or sub-system so as to test the system to his satisfaction or for gaining additional information and knowledge. In case any dispute or disagreement arises between the manufacturer & RDSO during the process of testing as regards the type test and/or the interpretation and acceptability of the type test results, it shall be brought to the notice of the Director General (Traction Installation), RDSO whose decision shall be final and binding.

8.3 Design tests: These tests are intended to verify the suitability of the design, materials and method of manufacture (technology). The following design tests shall be carried out by the manufacturer as per **IEC 61109 Ed-2 (2008-05)** or the latest version and records shall be maintained. The test report shall be furnished by the manufacturer along with the offer.

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i	Tests on interfaces and connections of end fittings	ii	Assembled core load-time test
iii	Tests on shed and housing material	iii	Tests on the core material

## 8.4 Tests:

- 8.4.1 Type tests shall be carried out on three components/assemblies unless otherwise specified, to demonstrate the suitability of the design, materials and method of construction and the capability of the manufacturer to produce the neutral section assembly in accordance with the specification. All such tests shall be witnessed by the representative of RDSO. The cost of samples or components destructed during type testing shall be borne by the manufacturer. The conductors required for testing of fittings etc. shall be arranged by the manufacturer at his own cost. All the samples shall satisfy the requirements of relevant clauses.
- 8.4.2 Only after clear written approval of the results of the tests on the prototype is communicated by the RDSO to the manufacturer shall be take up bulk manufacture of the SNS which shall be strictly with the same material and Process as adopted for the prototype. In no circumstances shall the material other than those approved in the design/drawings and/or the prototype be used for bulk manufacture on the plea that they had been obtained prior to the approval of the prototype.
- 8.4.3 The manufacturer shall offer the neutral section assemblies in lots of not more than 100. Two complete assemblies shall be selected at random for acceptance tests. Only if there is no failure at all, the lot shall be accepted. If any failure occurs the entire lot shall be rejected.
- 8.4.4 Acceptance and routine tests as below shall be conducted by manufacturer. Test record shall be maintained by manufacturer and produced, if required by the purchaser/ testing authority.
- 8.4.5

Test's table

SN	Type of Test	Type Test	Acceptance Test	Routine Test	Clause No.	
i	Visual examination of components	Yes	Yes	Yes	9.1	
ii	Dimensional verification of components	Yes	Yes	No	9.2	
iii	Dimensional examination of complete assembly	Yes	Yes	No	9.2	
iv	Interchangeability of components	Yes	Yes	No	9.3	
v	Physical and chemical tests	Yes	Yes	No	9.4	
vi	Radiographic examination of castings	Yes	No	No	9.5	
vii	Liquid dye penetration test on castings and forgings	Yes	Yes	Yes	9.6	
viii	Load test on end fittings of catenary and contact wire	Yes	Yes	No	9.7	
ix	Chemical analysis of other fittings/ components	Yes	Yes	No	9.8	
x	On insulators	Dry lightning impulse withstand voltage	Yes	No	No	9.9
xi		One minute wet power frequency withstand Voltage test	Yes	No	No	9.10
xii		Load time test	Yes	No	No	9.11
xiv		Mechanical routine test	No	No	Yes	9.12
xiii	Tests on fasteners	Yes	Yes	No	9.13	
xv	Test on SNS assembly after installation on OHE	Yes	No	No	9.14	

## 9. TEST METHODS:

- 9.1 Visual examination of components: All components of the assembly shall be carefully examined to see that they are free from defects, deformations, flaws and have smooth surface finish. Particular attention shall be paid to smooth finish of contact surfaces of runners/ gliders. The visual examination of contact and catenary wire insulators shall be carried out as per clause 13.2 of IEC: 61109 Ed-2 (2008-05).
- 9.2 Dimensional verification of components: The dimensions of the components of the complete assemblies selected in accordance with clause 12.2 of 61109 Ed-2 (2008-05) for type tests & for acceptance tests and all major dimensions of the complete assembly shall be checked ~~and shall be~~ as per manufacturer's drawings approved by RDSO. The Runners/gliders shall meet the requirements specified under clause 4.
- 9.3 Interchangeability of components: If any of the components selected at random permit their assembly without any further machining or forming operations with other matching components and the assembly so made meet the requirements of clause 9.2, the requirement of this test shall be deemed to have been complied with.
- 9.4
- 9.4.1 For each material used for ferrous/non-ferrous castings and forgings etc the manufacturer shall test one of the two test bars from each melt/lot for physical properties and chemical composition. Only if the test results are in conformity with relevant standards the fittings/components from that melt/lot shall be utilized and offered for acceptance otherwise the lot shall be re-melted.
- 9.4.2 The second test bar shall be tested by the Inspector for each lot of fittings/ components from each melt/lot for physical properties only. If the requirements of physical properties are not met with, the particular lot shall be rejected and fittings/ components broken or re-melted in the presence of the Inspector. If the requirement of physical properties is met with the lot shall be accepted.

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- 9.5 Radiographs of the castings (ferrous and Non-ferrous) selected for the purpose shall be taken and evaluated by RDSO for inclusions, blow holes, cavities, cracks, porosity etc. if the casting fail in radiographic examination, the lot shall be rejected and destroyed in the presence of inspecting authority. The accepted radiographs shall be retained By RDSO.
- 9.6 All the castings and forgings (ferrous and non-ferrous) shall be tested for cracks, porosity etc. by the liquid penetrate flaw detection method in accordance with **IS 3658:1999(R2005)** and shall satisfy the requirements of the specification.
- 9.7 A suitable length of the conductor with which the end fittings are intended to be used, shall be fixed in the fitting with bolts and nuts tightened with specified torque. The assembly shall be held in a tensile testing machine. A tensile load of fifty percent of the breaking load of the conductor shall be applied and the conductor shall be marked in such a way that the movement relative to fitting can be easily detected. Without any subsequent adjustment of the fitting, the load shall be increased to 90% of the breaking load of the conductor and maintained for one minute. There shall be no movement of the conductor relative to the fitting during this period and no failure of the fitting. The load shall further be increased till the failure of fitting or conductor. Failure of fitting shall not occur at a load below 95% of the breaking load of conductor. The minimum failing load of conductors is given at Clause 3.3.
- 9.8 All **other** fittings/components shall be chemically analysed The chemical composition shall be in accordance with the relevant specifications mentioned in the approved drawings.
- 9.9 The insulators shall withstand 1.2/50 microsecond, impulse voltage of value as specified by the manufacturer in their design document approved by RDSO for positive and negative polarity when tested in accordance with clause 11.1 of IEC-61109 Ed-2 (**2008-05**).
- 9.10 The insulators in horizontal position shall withstand one minute wet power frequency voltage as specified by the manufacturer in their design document and in schedule of guaranteed technical particulars (Annexure III) when tested in accordance with clause 11.1 of IEC 61109 Ed-2 (**2008-05**).
- 9.11 Mechanical load **time** test on insulators: The insulators shall be tested in accordance with clause 11.2 of IEC 61109 Ed-2 (**2008-05**). In continuation, the load shall further be increased till failure occurs. Failure of fittings/joint/insulator rod of insulator shall not occur below 9900kgf.
- 9.12 Mechanical routine test on insulators: Every insulator of the lot shall be tested in accordance with Clause 13.1 of IEC 61109 Ed-2 (**2008-05**).
- Stainless steel fasteners when tested shall conform to grade A4 property class 50 ~~or class 80~~ of ~~BS6105-1981~~ **ISO 3506-1:1998** or equivalent international standard as specified by the manufacturer and approved by RDSO.
- 9.13 Prototype SNS assembly shall be installed by the manufacturer on OHE at neutral section location with the assistance of Railways. After installation locomotive/ EMU shall be moved under the neutral section in following steps and SNS assembly shall meet the performance requirement as specified in this specification & particularly the requirement of clause 3.6 & 4.3.
- 9.13.1 Movement with circuit breaker in OFF Condition at maximum permissible speed of that section one time in each direction.
- 9.13.2 Movement with circuit breaker in ON Condition at approximately 15 kmph and at maximum permissible speed of that section, twice in each direction.

**9.13.3 After successful completion of above trial, the same assembly shall be put in trial for three months.**

**10.0 The "Make in India" policy-2017 of Government of India shall be applicable.**

#### Annexure-I Schedule of Guaranteed Technical Particulars

SN	Parameter /Unit	SN	Parameter /Unit
1.	<b>Assembly</b>	v	Specified mechanical load
A	Operating Speed potential -Km/h	vi	Routine test load - Kgf
B	Total length -M	vii	Tensile failing load - kgf
C	Neutral length (Middle Portion) -M	viii	1.2/50microsec.dry lightning impulse withstand voltage +VE polarity kVp, -Ve polarity - kVp
D	Total weight -Kg	ix	Wet one minute power frequency With stand voltage -kV(rms)
E	Safe working load	x	Creepage path -mm
i	Contact wire side -Kgf	xi	Safe working load - kgf
ii	Catenary conductor side - Kgf	<b>3. Fittings</b>	
iii	Assembly -Kgf	A	Castings
F	Suitable for AM 12 and AM-92 Pantograph with metalized carbon strip/pure carbon strips -Yes/No	i	Type of casting(sand cast/die cast/pressure die cast)
G	Suitable for erection symmetrically on the cantilever assembly -Yes/No	ii	Material with specification) and grade of each Casting (name the castings also)

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H	Permissible stagger at support for erection -mm	iii	Mechanical properties of the test bars for Respective castings : a) tensile strength kgf/sqmm; b) elongation for a gauge length...mm %; c) yield strength or other stresses kgf/sqmm
I	Permissible Minimum radius of curvature of track -M	B	Other fittings: Material with specification and grade of each fitting.
J	Permissible Maximum gradient of track	C	End Fittings: Failing load <b>a)</b> Contact wire-kgf; b)Catenary wire -kgf
		iv	Creepage distance
<b>2.</b>	<b>Insulators</b>	<b>4.</b>	<b>Fasteners</b>
A	Contact wire side:	a	Material with specification and grade
i	Material and specification with grade of core.	b	Salient mechanical properties of
ii	Material and specification with grade of covering.	c	Freedom from carbide precipitation-yes/No
iii	Material and specification With grade of end	d	Resistant to inter-crystalline corrosion -
iv	Type of coupling of end fittings With core.	<b>5.</b>	<b>Earth wire (if applicable)</b>
v	Specified mechanical load.	a	Material with specification and grade
vi	Routine test load - Kgf	b	Construction
vii	Tensile failing load Kgf	c	Mechanical failing load -Kgf
viii	1.2/50 micro sec. dry lightning impulse Withstand Voltages +ve Polarity kVp -ve Polarity kVp	<b>6.</b>	<b>Provision of identification marking</b>
ix	Creepage distance		
B	Catenary Conductor Side:	a	Insulators Yes/No
i	Material of core and specification with Grade	b	Fittings and components -Yes/No
ii	Material of covering and specification with	<b>7.</b>	<b>Interchangeability of components</b>
iii	Material of end fitting and specification		
iv	type of coupling of end fittings With core Crimped/bolted/other		

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